Comparison between Google Earth kml data and RTK data on a flight planning simulated to the Unmanned Aerial Vehicle Microdrone MD4-1000.

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Abstract

The unmanned aerial vehicles (UAVs) and the use of graphical data files, of extension kml, have become popular nowadays. The kml files are associated to the Google Earth applications. Developed by Microdrone company for planning, overflight simulation and data flight analysis, the program mdCockpit was used in this experiment. The UAV Microdrone's flight path was programmed in two ways: using georeferenced images from Google Earth and entering points coordinates into the program. These points have had their geographical decimal coordinates collected by GPS (RTK) method. The aim here is to describe a way of evaluating the difference between the alternatives of flight planning. A flight path, defined a route with 22 points, was also simulated in the program mdCockpit. The points were collected and saved, while the images captured by the program went automatically forming a georeferenced mosaic. A comparison between the difference of coordinates to each point was made by choosing on the images and also by a RTK positioning. The result was up to 14.20 m to a 100 meters flight height. There is a significant change of position and this can result in unwanted over flights in locations or even jeopardizing the safety of air activity.

Keywords: simulation flight path, md4-1000, kml data, RTK data

1.   Introduction

The unmanned aerial vehicles are becoming ever more common, occupying an important place in so many applications. Especially in the military sphere, where it has been invested in this technology more than the civil normally has done. The University of Santa Maria (UFSM) recently purchased one of this type of unmanned aerial vehicle (UAV) called 1000 MD4, for using it in aerial imagery of the environmental studies and in precision agriculture. Developed by Microdrone, this UAV comes with a software called Mdcockpit that can perform flight data analysis but also route planning. As suggested by Cartogalicia, 2010, Mdcockpit performs best when images from Google Earth are used for planning flight paths.

Images provided by Google Earth can be used as alternative sources on supporting to flight simulations. Also known as Google Satellite, GeoEye is a satellite that can deliver images in a range less than 2 meters of spatial resolution. Depending on its sensor, panchromatic or multispectral, each one can reach respectively 0.45m and 1.65 m of spatial resolution (Geoeye, 2012). In this experiment, only images GeoEye from campus UFSM have been used in the construction of a mosaic. By searching for similar papers on the literature, it was possible to conclude how rare is the subject like this one here. Almost all similar works have been made by military groups and they did not publish them. But one of these few similar (Pérez *et al*, 2011), also used the same software MdCockpit and affirms that Google Earth it is connected to the module mod-waypoint editor and integrated into the software.

A GPS high precision method is the Real Time Kinematic (RTK) positioning. It can achieve sub-metric precisions, and better, results in centimeters. It has the ability of the rover to resolve ambiguities while the receiver antenna is in motion (Seeber, 2003). So many others authors refer to the cadastral precisions of RTK (Afonso *et al* 2006, Jarroush *et al*, 2005). Therefore, as a control group, the points surveyed by RTK can offer enough precision to the proposes in an experiment like this one. By the way, the aim of this paper is to describe a way of evaluating the difference between two alternatives of flight planning.

The Keyhole Markup Language (KML) is a file format used to display geographic data in an Earth browser such as Google Earth or Maps, etc. (GOOGLE, 2012). So KML can provide points, stored in a list of coordinates, that are able to be edited.

2. Methods

Basically, three stages have been included in the methodology for this study: Google Earth Applications, Mdcockpit operations and Flight Routes Results. In order to offer a better understanding, a flowchart is presented (Figure 1) as an illustration of the details that involved each stage in the methodology.
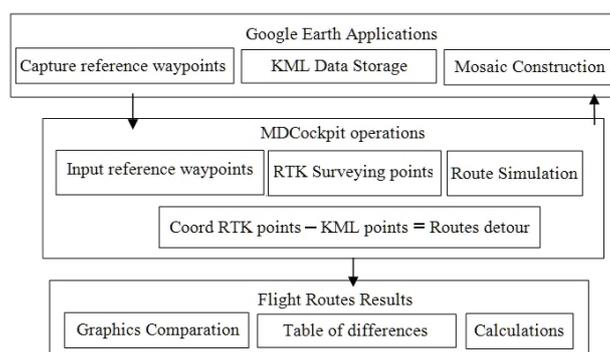

Figure 1: Work flowchart

The small models like UVA 1000 MD4 in general are designed to fly short pathways at low altitude. The length of the flight simulation was 9100 meters at an altitude of 100 meters. So that during the construction of the mosaic, some obstacles or details could ever be hidden. This could represent a collision,

jeopardizing the safety of equipment. Then a pathway has been carefully designed. And in the rough layout of the path, high objects, obstacles, trees etc have been avoided not to occur collisions.

Mdcockpit application starts the capture of images by inserting from a initial coordinate. Little by little, it composes a mosaic georeferenced. Once the mosaic was created, a group of 22 points of interest have been choosing. They also formed the waypoints which defined the route of flight. Meanwhile, the same points of reference have been surveyed by RTK method GPS. Then, the routes simulation could be performed. The detour observed in the both routes can be expressed by the difference between coordinates list (Table 1). The results are discussed further next.

The coordinates obtained with the RTK system were consider here as "true", since these were obtained when the system accused an accuracy of up to 5mm. The length differences and the flight paths are calculated by Equation (1).

$$d_{ap} = \left(\left(X_p - X_a \right)^2 + \left(Y_p - Y_a \right)^2 \right)^{1/2} \qquad (1)$$

where: d_{ap} = distance between points; X_p = plan posterior abscissa; X_a = prior plan abscissa ; Y_p = plan posterior ordinate; Y_a = prior plan ordinate

3. Results

The images composition were captured always at 220 m in the view point in Google Earth, with zooming factor 2.0. There are no objects higher than 40 meters in the study area, therefore 100 meters was considered a good height. A comparative graphic of the routes can be seen in the Figure 2.

Figure 2: Graphic differences between routes RTK and KLM simulations

The yellow tracing represents the points of the RTK, considered as actual coordinates of the targets. In red, the route of flight planning done on the images of Google earth with KML. The points raised on the ground by RTK method GPS have been the same points entered in Google Earth and captured to the images mosaic of references.Each of the alternatives for route planning is subject to its accuracy scale, image resolution or the precision of the survey. The greatest errors has occurred on the point 18, it was 14.20 m (Table1). All points have had a scattering on average 5.85 m, with a standard deviation of 2.37 meters.

Table 1: Differences between RTK and KML Coordinates

Points	Google Earth Coordinates (UTM)		RTK Coordinates (UTM)		Differences(m)
1	6708617.7	237467.37	6708612.1	237464.26	4.77
2	6708669.1	237724.54	6708665.6	237721.52	4.83
3	6708895.7	237705.5	6708888.6	237701.22	8.13
4	6709040.6	237675.43	6709034.5	237672.27	5.74
5	6709177.8	237768.62	6709174.5	237771.19	3.70
6	6709309.3	237628.84	6709303.6	237625.11	3.18
7	6709760.8	237644.01	6709756.7	237639.82	5.28
8	6709963	237305.18	6709958.8	237302.6	4.36
9	6710162.2	237170.71	6710156.5	237165.97	7.59
10	6710032	236978.1	6710025.9	236974.75	6.83
11	6709466	235621.2	6709463	235617.7	5.23
12	6709467.7	236169.69	6709462.8	236164.16	6.85
13	6709594.9	236817.24	6709589.4	236814.29	6.18
14	6709660.2	237089.36	6709654.7	237086.6	5.16
15	6709263.7	237347.16	6709256.1	237342.91	7.33
16	6709182.3	237156.18	6709175.2	237151.94	6.88
17	6708941.2	237136.41	6708936.1	237133.93	3.89
18	6708854.7	236594.17	6708840.6	236585.97	14.20
19	6708765.8	236146.54	6708762.1	236143.87	4.80
20	6708163.1	236898.68	6708159.4	236894.86	3.79
21	6708223.4	237255.57	6708220.3	237254.43	2.47
22	6708558.8	237205.67	6708552.2	237202.96	7.35
Standard deviation = 2.37 m			Average = 5.85m		

Only point 18, a significant change of position could result in a over flights unwanted or even jeopardize the safety of air activity.

4. Conclusions

This work showed that is possible to mark directly on the Google Earth images when you want to draw flight paths. They are easy to apply, but got little lacking in precision resulting. It is necessary to take the precaution of a reasonable safety over the intended target on the route. The construction of the mosaic by capturing images from Google earth was very empirical and can take too much time.

Something that can be consider here is that no information about the images from GeoEye is showed by the Mdcockpit during the operations. All those considerations lead us to conclude that the work does not end here. There are so many tests yet to be done in future works.

Acknowledgments

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